

## SECTION 16670

## LIGHTNING PROTECTION SYSTEM

## 1 GENERAL

## 1.1 SUMMARY (NOT APPLICABLE)

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## FEDERAL SPECIFICATION (FS)

FS W-S-610 (Rev D; Notice 1) Splice Connectors

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1993) National Electrical Code

NFPA 780 (1992) Lightning Protection Code

## UNDERWRITERS LABORATORIES (UL)

UL 96 (Sep 4, 1985; 3rd Ed; Rev thru Dec 5, 1988)  
Lightning Protection Components

UL 96A (Apr 9, 1982; 9th Ed; Rev thru Jul 6, 1990)  
Installation Requirements for Lightning  
Protection Systems

UL 467 (Nov 22, 1984; 6th Ed; Rev thru Nov 14, 1986)  
Grounding and Bonding Equipment

## 1.3 GENERAL REQUIREMENTS

## 1.3.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

## 1.3.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 78, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTALS:

### SD-04 Drawings

Lightning Protection System; GA.

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

### SD-13 Certificates

Materials and Equipment; GA.

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL-03 will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings, certifying UL inspection of all lightning protection systems provided on buildings used for manufacturing, processing, handling or storing explosives, ammunition, or explosive ingredients.

## 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, or Class II, as applicable.

### 2.1.3 Air Terminals

Terminals shall be in accordance with [UL 96](#) and [NFPA 780](#). The tip of air terminals on buildings used for manufacturing, processing, handling, or storing explosives, ammunition, or explosive ingredients shall be a minimum of 2 feet above the ridge parapet, ventilator or perimeter. On open or hooded vents emitting explosive dusts or vapors under natural or forced draft, air terminals shall be a minimum of 5 feet above the opening. On open stacks emitting explosive dusts, gases, or vapor under forced draft, air terminals shall extend a minimum of 15 feet above vent opening. Air terminals more than 24 inches in length shall be supported by a suitable brace, with guides, not less than one-half the height of the terminal.

### 2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to [UL 467](#). Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length. Ground rods of copper-clad steel shall not be mixed on the job.

### 2.1.5 Clamp-Type Connectors

Connectors for splicing conductors shall conform to [UL 96](#), class as applicable, and [FS W-S-610](#), Class 2, style and size as required for the installation.

### 2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, clips, and fasteners shall conform to [UL 96](#), classes as applicable.

## 3 EXECUTION

### 3.1 INTEGRAL SYSTEM

#### 3.1.1 General Requirements

The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground without passing through any nonconducting parts of the structure. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

##### 3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with [NFPA 780](#). Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet.

In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inches for each foot of increase over 25 feet. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Where metal ventilators are installed, air terminals shall be mounted thereon, where practicable. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom thereof.

#### 3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest.

#### 3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected where necessary, to prevent mechanical injury to the conductor.

#### 3.1.1.4 Interconnection of Metallic Parts

Metal doors and door guides shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors and door guides shall be by means of mechanical ties under pressure, or equivalent.

#### 3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal. All underground connections shall be exothermically welded.

#### 3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 2 feet, nor more than 10 feet, from the structure. The complete installation shall have a total resistance to ground of not more than 10 ohms. A counterpoise shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2-1/2 feet deep at a distance not less than 2 feet nor more than 10 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors are then buried in the trenches.

#### 3.1.2 Magazines

In earth-covered precast concrete magazines, the miscellaneous steel elements and the reinforcing steel shall be made electrically continuous. Electrical continuity may be provided by clipping, brazing, or tying unless a specific method is noted on the drawings. The air terminals and roof conductors shall be securely connected to, and made electrically continuous with, the reinforcing steel. One air terminal shall be located on the top of the front wall and one on or adjacent to the ventilator in the rear. The air terminals shall extend vertically at least 2 feet above the top of the front wall and the highest point on the ventilator. Down conductors and grounding electrodes shall be provided at diagonally opposite corners of the magazine and shall be connected together. Grounding electrodes shall be connected to the horizontal reinforcing rods below the floor line of the wall system. The steel door frame shall be made electrically continuous with the steel panels and the reinforcing steel. The steel door shall be connected to the steel frame by means of a flexible copper strap or cable unless the steel hinges make the door and frame electrically continuous.

#### 3.2 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer. The Contractor will have sole responsibility of meeting all requirements of specifications and drawings.